Art. VIII.—*Notes on the Longitude of the Melbourne Observatory.*

By E. J. White, Esq.

[Read before the Royal Society of Victoria, 25th September, 1876.]

The Melbourne Observatory having been selected by the American and German parties charged with the observation of the last transit of Venus in these parts of the world as a principal station of reference for the determination of the longitudes of their stations, it becomes a matter of some importance to investigate the authority on which the longitude of the Melbourne Observatory itself depends.

The longitude of Melbourne Observatory was originally determined from that of Williamstown by means of triangulation. The longitude of Williamstown Observatory was found by means of moon culminations observed in the years 1860, 1861, and 1862; of these 142 were compared with corresponding observations at Greenwich and the Cape of Good Hope, from which 9h. 39m. 38·8s. was computed and adopted as the longitude east of Greenwich; the triangulation showed that the Melbourne Observatory was 16·00s. to the east of Williamstown, so that 9h. 39m. 54·8s. was adopted for the former. In the year 1874 we were requested by the German Commissioners entrusted with the management of the transit of Venus expeditions to observe all the moon culminations that were visible in Melbourne during the months of October, November, and December, in 1874, and January of the next year. This was done, and we succeeded in observing 29 culminations of the first limb, and 20 of the second limb. On finally reducing these observations lately, it became a matter of interest to see how this independent determination of our longitude would agree with the one derived from Williamstown. Sir George Airy, the Astronomer Royal, having recently obligingly furnished us with the observations of the moon taken during the same period at Greenwich, it became possible to easily determine this agreement without directly computing the longitude. This was done in the following manner:—The Greenwich list contains the Nautical Almanac errors of the moon's right ascension, as found from actual observation at Greenwich; the errors of the Nautical Almanac were also computed from the Melbourne observations, using our adopted longitude; if, now, the Melbourne errors for the same dates come out the same as the Greenwich

errors, it may be inferred that our adopted longitude is correct, or any difference that may be found could be converted into a correction of our adopted longitude. On comparing the Greenwich and Melbourne lists it was found that on fifteen days the moon had been observed at both places, and on interpolating the Greenwich errors, to make them correspond to the time of the Melbourne errors, and taking their mean, it was found that the mean error of the Nautical Almanac was + 0·58s. from the Greenwich observations, and +0·57s. from the Melbourne ones. These results are so nearly identical as to show that our adopted longitude is quite as accurate as can be possibly obtained from the method of moon culminations. A distinguished American mathematician, Professor Peirce, of Harvard University, from theoretical considerations, estimated one second of time as the utmost limit of accuracy to be obtained by this method. Professor Hall, however, of the Washington Observatory, has recently discussed the longitude of his Observatory, as determined by means of the Atlantic cable, transportation of chronometers, and moon observations; and assuming the telegaphic result to be the correct one, he finds a difference of rather more than two seconds to exist between the moon and electric determination, while the chronometric and electric results are nearly identical. Now, if we convert the above difference between the errors of the moon's place, as found at Greenwich and Melbourne into a correction of the latter's longitude, it will amount to only three-tenths of a second; combining this with a weight proportional to the number of observations from which it is derived, it would indicate an increase to our adopted longitude of only three-hundredths of a second of time. Having thus reached the limit of accuracy of which the method of moon culminations is capable, any other determination of our longitude would have to be made either by transmission of large numbers of chronometers—a very expensive and troublesome process—or by means of the electric telegraph. In conclusion, I will state that I consider the longitude of Melbourne to be as well determined as that of any other place in the Southern hemisphere, and better than that of any other place in Australasia. The only other places in Australia where long-continued observations of moon culminations have been made for finding the longitude are Parramatta and Sydney; at both of these places, however, very inferior instruments were used. For the latter place, however, a fine transit circle, of

greater power than the Melbourne one, has been lately constructed, and is now daily expected to arrive from England; and as the difference of longitude between Melbourne and Sydney has been accurately measured by means of the telegraph, it will be easy to compare its longitude results with our own. At the Adelaide Observatory no special observations for longitude have as yet been taken. There, also, the Government is just about to order a transit circle, the telescope of which will be somewhat larger than our own; and as the difference of longitude has also been telegraphically determined, its results will be immediately comparable with our own. The acquisition of two such fine instruments by the neighbouring Observatories is a matter for congratulation, and will enable them in future to take their share of the immense work to be done in the Southern hemisphere, an undue proportion of which has lately fallen to Melbourne.

Art. IX.—*Notes on Iron Arches.*

By W. C. Kernot, M.A., C.E.

[Read 25th September, 1875.]

The application of iron, and especially of wrought iron, to bridge-building is deservedly ranked as one of the most notable of those innovations in civil engineering practice that have been made in modern times. It has enabled us to cross chasms of enormous width and depth, and to erect safe and commodious structures in situations and under circumstances which would in many cases totally preclude the employment of the materials known to the bridge-builders of an earlier date. So long as stone and brick were the only available materials, the engineer was confined in his choice to small spans, and to sites where a thoroughly sound foundation was easily attainable. The largest stone arch ever constructed, as far as I can ascertain, is considerably less than 250 feet span, while iron structures on the arch or girder principle of double, and on the suspension principle of three times, this span are by no means uncommon, and we are yet far from approaching the limit of the maximum possible span in this material. Moreover, iron bridges can be employed with perfectly satisfactory